

Survey of Sgurr a' Chaorainn

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The Team:

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1) Introduction

Sgurr a' Chaorainn (Hill 1359, Section 18B, OS 1:50000 Map 40, OS 1:25000 Map 391, Grid Ref NM895662) is listed as a Graham with a height of 761m. Spot heights from photogrammetry have a measurement uncertainty of +/-3m and in addition the summit of the mountain is quite rocky so it is quite possible that the highest point has been missed by the photogrammetrist. Consequently, there is a reasonable chance that the summit may be higher than 761m and that Sgurr a' Chaorainn could therefore be close to or above the criterion height of 762m required for a Corbett.

The purpose of this survey was to locate and measure accurately the height of the mountain and thereby clarify its status.

2) Equipment used and Conditions for Survey

Ground surveys to determine the position of the summit were carried out using a Leica NA730 Professional Automatic level (X30 telescopic system)/tripod system and a "1m" E-staff extendable to 5m.

Absolute heights were measured using a Leica Geosystems Viva GS15 Professional receiver. This instrument is a dual-frequency, multi-channel instrument, which means it is capable of locking on to a maximum of 12 GPS and 8 GLONASS satellites as availability dictates, and receive two signals (at different frequencies) from each of these satellites. The latter feature reduces inaccuracies that result from atmospheric degradation of the satellite signals. As a stand-alone instrument it is capable of giving position and height to an accuracy of about two metres and five metres respectively. Note that small hand-held GPS receivers used for general navigation can only receive up to 12 GPS satellites and each at a single frequency and therefore these instruments have a poorer positional accuracy of +/-5metres and a height accuracy of no better than +/-10 metres. Some recently produced hand held GPS Garmin receivers can also receive signals from GLONASS satellites which greatly improve the speed at which these units can achieve a satellite "fix". Despite the on-board features of the Viva GS15 receiver, there are still sources that create residual errors. To obtain accurate positions and heights, corrections were made to the GNSS (Global Navigation Satellite System) data via imported RINEX data from the Ordnance Survey. These were post-processed using Leica Geo Office 8.3 software.

Conditions for the survey, which took place between 12.15hr and 15.00hr GMT, were fair. The weather was a little cloudy but with good sunny periods and the temperature was about 5 degrees Celsius, although it felt much colder in the stiff breeze.

3) The Survey

3.1) Character of Hill

Sgurr a' Chaorainn lies in Ardgour to the North of Strontian and behind Garbh Bheinn, the prominent Corbett that is seen from Loch Linnhe. It is most easily climbed from Ariundle, the locality just North of Strontian, which lies on the minor road to the remote habitation of

Pollach. A right fork in the road at Ariundle terminates in a car park and from there continues as a good track. After about 3km this track forks, the left-hand branch leading to an old lead mine and the right-hand branch leading down to the Strontian River. This branch peters out there, but the river is followed upstream for the next 2.5 kilometres whereupon easy slopes lead to the narrow bealach between Sgurr a' Chaorainn and Sgurr na h-Ighinn, an outlying top of the Corbett Sgurr Dhomhnuill. A steep but straightforward climb of 250m through small crags and outcrops then leads to the summit of Sgurr a' Chaorainn, which comprises a small cairn on an outcrop of rock. The view from the top is spectacular with Garbh Bheinn dominating the skyline to the South and Sgurr Dhomhnuill, which at 880m is the highest of the local group of hills, the view to the North. The view to the South-East down Glen Gour leads the eye across Loch Linnhe to the hills of Glen Coe and the Mamores. The mountain itself is very steep on all sides and defended by crags, save for the route of ascent described and its continuation to the Corbett of Beinn na h-Uamha that lies 2.5km to the East. There is no sign of habitation to be seen from the summit which adds to the feeling of remoteness in this spectacular area of Scotland.

3.2) Summary of Survey Method

The survey commenced with level and staff measurements to determine the highest point of the summit area and GNSS data were then collected with the Leica Viva GS15.

3.3) The Summit

The Leica NA730 automatic level was setup on a tripod at a convenient position about 3m away from the summit cairn. Staff readings were then taken systematically in the area around the cairn and the summit position was confirmed to be a large rock 1m SW of the cairn. This rock was too large to enable the Leica Viva GS15 to be set up over it and consequently a convenient set-up position was chosen by the cairn and the level and staff were used to determine the height difference between the set-up position and the summit.

Staff reading on summit rock = 0.416m

Staff reading on set-up position = 0.453m

Set-up position is $0.453 - 0.416 = 0.037\text{m}$ lower than summit

Next the tripod was placed over the set-up position and the Leica Viva GS15 was then fixed to it with a clamp and tribrach (the "short tripod" configuration). The height of the receiver above the rock (the vertical offset – see photograph in the Appendix) was then measured with the integral tape. The vertical offset from measuring point to the ground was 0.420m (see photograph) plus 0.255m for the tribrach/hook system.

GNSS data were collected for 2 hours with an epoch time of 15 seconds.

The ten-figure Grid References measured for the summit were:-

Garmin Montana 600	NM 89504 66194	Height = 770m
Garmin Etrex 20	NM 89499 66194	Height = 765m
Garmin Oregon 450	NM 89503 66193	Height = 765m

The position and height data for the summit that were recorded by the Leica Viva GS15 were post-processed with Leica GeoOffice 8.3 using imported OS RINEX data for the seven

nearest base stations and the Computed model for tropospheric correction. These result is given in the table below for which the vertical offset (0.420m + 0.255m) has been subtracted and height difference of 0.037m between set-up and summit position added as part of the processing:-

System	Easting	error(1SD)	Northing	error(1SD)	Height(m)	error(1SD)
GS15	189497.254	0.003	766203.243	0.003	760.618	0.006

The height of Sgurr a' Chaorainn is 760.618m

4) Summary of Operating and Process Conditions

	GS15
Data collection summit (min)	120
Number of Base Stations used in Processing for all points	7
Epoch Time (sec)	15
Tropospheric Model	Computed
Cut off Angle (degs)	15

5) Discussion of Results

The uncertainties in the height measurement taken by the GS15 for the summit are +/-0.005m associated with its location and +/-0.05m for the GNSS 2 hour data set. This gives an overall uncertainty in the summit height of +/-0.05m.

Consequently, the result confirms that Sgurr a' Chaorainn, at 760.6m does not qualify as a Corbett and therefore retains its status as a Graham.

6) Summary and Conclusions

The **summit of Sgurr a' Chaorainn** is at grid reference * NM 89502 66194 and is a large rock 1m South West of a small cairn. Its height is **760.62+/-0.06m**.

Sgurr a' Chaorainn retains its status as a Graham.

* NB average hand-held Garmin/Magellan GPS grids are quoted in the summary.

John Barnard, Graham Jackson 08 April 2014.

Appendix 1



Surveying for Summit Position



Summit GS15 Vertical offset at 0.420m



Leica Viva GS15 collecting data at set-up position by cairn

Appendix 2

The height of Beinn na h-Uamha

During our work on Beinn a' Chaorainn the level was also used to observe Beinn na h-Uamha just 2.23km to the East. The photograph below shows the view through the level of the summit cairn on an outcrop of rock.



The horizontal line is shown cutting just below the cairn and is the height of Sgurr a' Chaorainn (760.62m) plus the height of the level above the summit (0.416m: see text). This is more clearly seen in the magnified image below. The stadia lines enable height differences to be calculated provided the distance between the level and the object is known, which in this case is 2.23km. The stadia lines are the short horizontal lines seen just above the snow patch in the photograph (the lower stadia line) and the one just visible on the edge of the view an equal distance above the horizontal line (the upper stadia line). The distance between the two stadia lines is $1/100^{\text{th}}$ of the distance between the level and the object in view, which in the case is $1/100^{\text{th}}$ of 2.23km, that is 22.3m. From this measurement the height of the base of the cairn above the horizontal line is found to be 0.52m. Earth curvature over 2.23km is 0.38m making the summit of Beinn na h-Uamha $760.62 + 0.38 + 0.42 + 0.52 = 761.9\text{m}$ assuming there is not higher ground hidden either under or

behind the cairn. Clearly, the status of Beinn na h-Uamha requires confirmation and will be the subject of a survey by us in May.



Magnified image showing the cairn more clearly and the horizontal line passing beneath it